

Analysis and Integration of Acoustic, Optical and Traditional Zooplankton and Mesopelagic Data from the Arabian Sea 1995 Field Program

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<http://www.aoml.noaa.gov/general/project/ocdpbo2.html>

LONG TERM GOAL

Our research has been and will continue to be directed at the coupled biological and physical mechanisms controlling the distributions of planktonic organisms, the ecological significance of these distributions in different ecosystems and the interaction between planktonic and other “biological particulates” within the upper coastal and oceanic water column.

OBJECTIVES

We wish to understand the relevant biological and physical mechanisms and ecological consequences with sufficient rigor to make quantitative predictions of the biological particulate field within open and coastal oceanic environments.

APPROACH

The underlying rationale of our approach has been the conviction that to link physical and biological information into a dynamical understanding requires collecting data on fully comparable time and space scales since the variability of the physical and biological processes is coupled in a highly complex and non-linear manner. In this endeavor we have developed a series of sampling tools including: in-situ silhouette photography, net sampler integrated high frequency acoustics, OPC-video smart sampling and have integrated systems used by other investigators –e.g., ADCP and hull-mounted sonar systems. The 1995 Arabian Sea expedition offered us a unique opportunity given the strength of the seasonal signal, the permanent presence in some areas of shallow intense oxygen minimum and the dramatic abundance, relative to other oceanic systems, of myctophid fishes and other mesopelagic fauna. The two ONR-sponsored cruises organized and led by our group, alone of all the many 1995 Arabian Sea cruises, systematically obtained faunal data across the entire size spectrum from microzooplankton to mesopelagic fishes to marine mammals and did so not only in the northern basin but also in the Somalia upwelling/Great Whorl.

WORK COMPLETED

All MOCNESS tow samples from the Arabian have been sorted to species and enumerated.

All ADCP and both 12 and 100kHz hull transducer data have been processed and reduced to graphical products

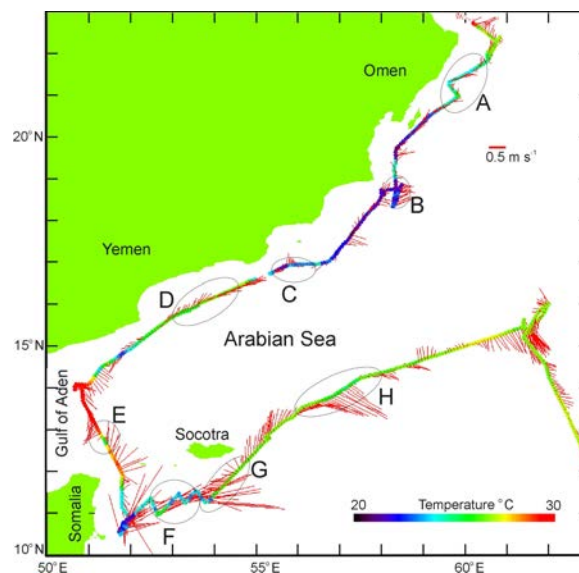
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All OPC, TAPS, CTD, IR backscatter and fluorometer data have been processed and reduced to graphical products and flat record files.

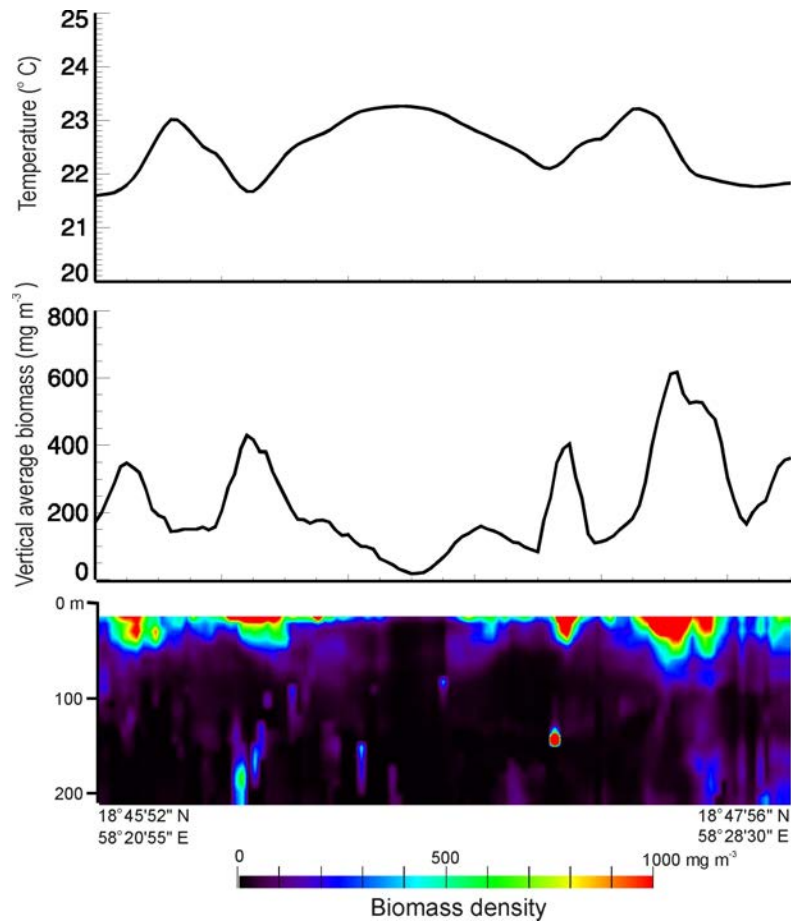
ADCP, hull transducer and CTD data have been incorporated into an analysis presented at the ICES meeting last Fall and now in a fuller form into a mss. accepted by Deep Sea Research for the third special volume on the Arabian Sea expedition of 1995.

RESULTS

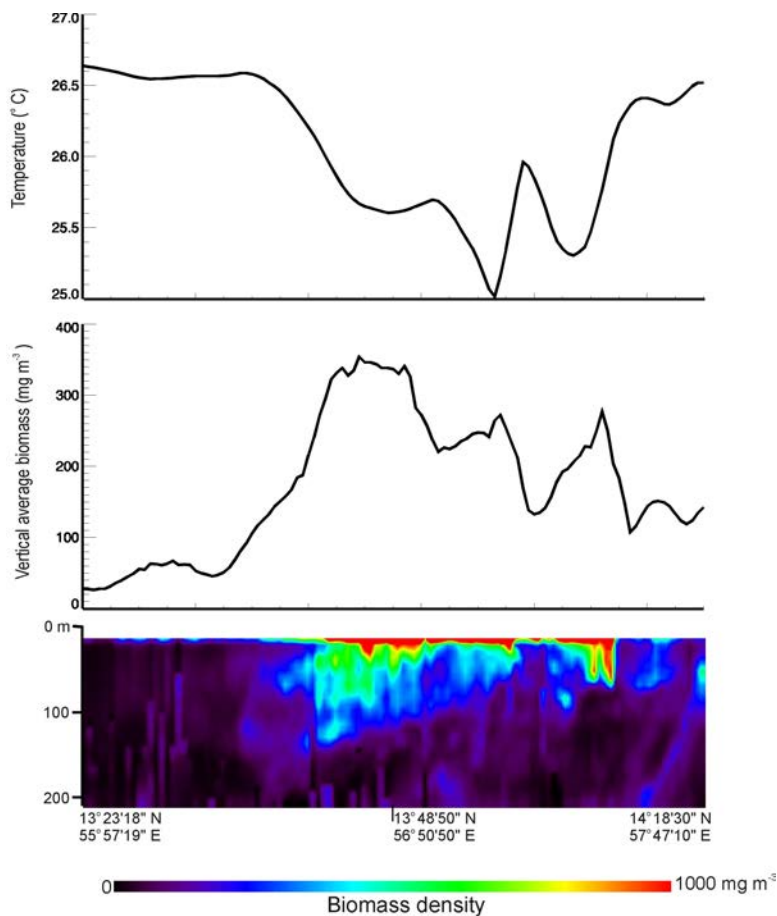
The principal results of our initial analysis are described in the mss. entitled: Diel vertical migration of zooplankton and mesopelagic fish in the Arabian Sea. As described therein, using a combination of net tow and acoustic methods we were able to distinguish the vertical distributions and migration patterns of zooplankton and mesopelagic fish populations and relate these to local hydrographic circumstances. Moreover, we documented a nearly fivefold increase in zooplankton biomass across the entire region both oceanic and coastal between our pre-northwest monsoon (May) and our late northwest monsoon (August) cruises. In collaboration with Dr. G. Hitchcock we are now investigating smaller scale upwelling features and current structure sampled during the August cruise (see Figure 1). Surface water temperature is represented along the track with a color scale from 20 to 30 degrees C. The surface current is represented with a red stick vector with a reference value of 0.5m/s in the upper right. The letters indicate sites where detailed analyses of biomass distribution are being made.



Representative coastal upwelling is depicted at station C as indicated by the very low surface temperatures seen and their proximity to a penninsular feature along the Omani coast. As the ship moved through this feature higher daytime zooplankton biomass was clearly associated with lower temperature values (Figure 2).



In contrast at site H well offshore we encountered a substantial clockwise eddy-like feature with somewhat lower surface temperatures and distinctly higher daytime zooplankton biomass along its perimeter.



IMPACT/APPLICATIONS

The approach we have used in using lower frequency sonar data and MOC01 and MOC10 tow data in conjunction with ADCP data substantially improves confidence in the interpretation of ADCP data collected by other vessels during the Arabian Sea expedition. Specifically, only daytime ADCP can be used with reliance as an estimate of zooplankton biomass in this region. The intermonsoon/late-monsoon biomass difference we observed markedly exceed those documented by any of the JGOFS or international cruises taken in the Arabian Sea in 1995 and are substantially influencing interpretation of seasonal effects.

TRANSITIONS

Using low frequency hull sonar data in conjunction with ADCP information represents a cost efficient and simple approach to resolving ambiguity that has to date compromised ADCP biomass inferences. We are already using it on a ship of opportunity effort with the Royal Caribbean Cruise Lines commencing later this winter.

RELATED PROJECTS

We employed the methodologies we developed for the Arabian Sea expedition during a pilot study of Florida Keys eddies this last May.

REFERENCES

None

PUBLICATIONS

Luo, J., P.B. Ortner, D. Forcucci and S.R. Cummings. Diel vertical migration of zooplankton and mesopelagic fish in the Arabian Sea. DSR Special volume (in press).